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U1S S1715 S1872

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GB 2182217 A GB 2068663 A GB 0748690 A
WO88/01450 A1

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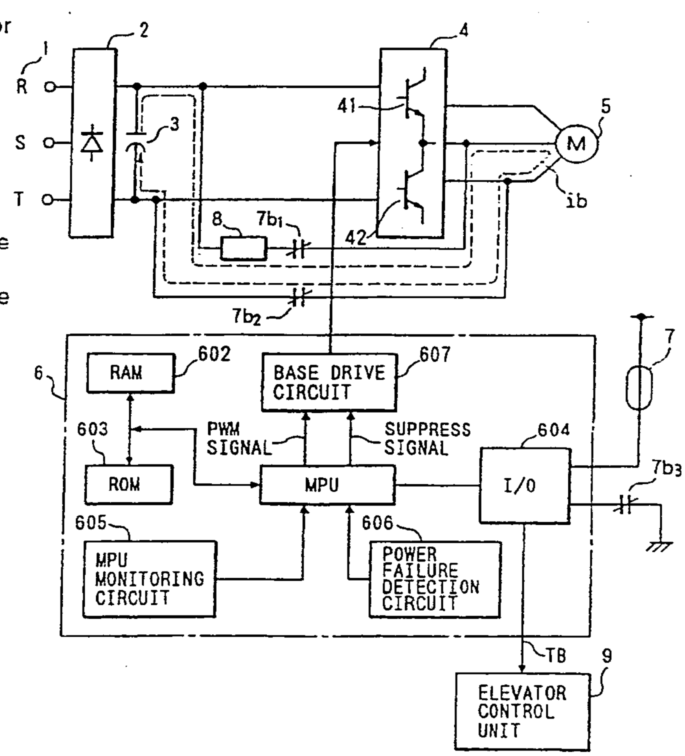
(54) **Motor driven door device**

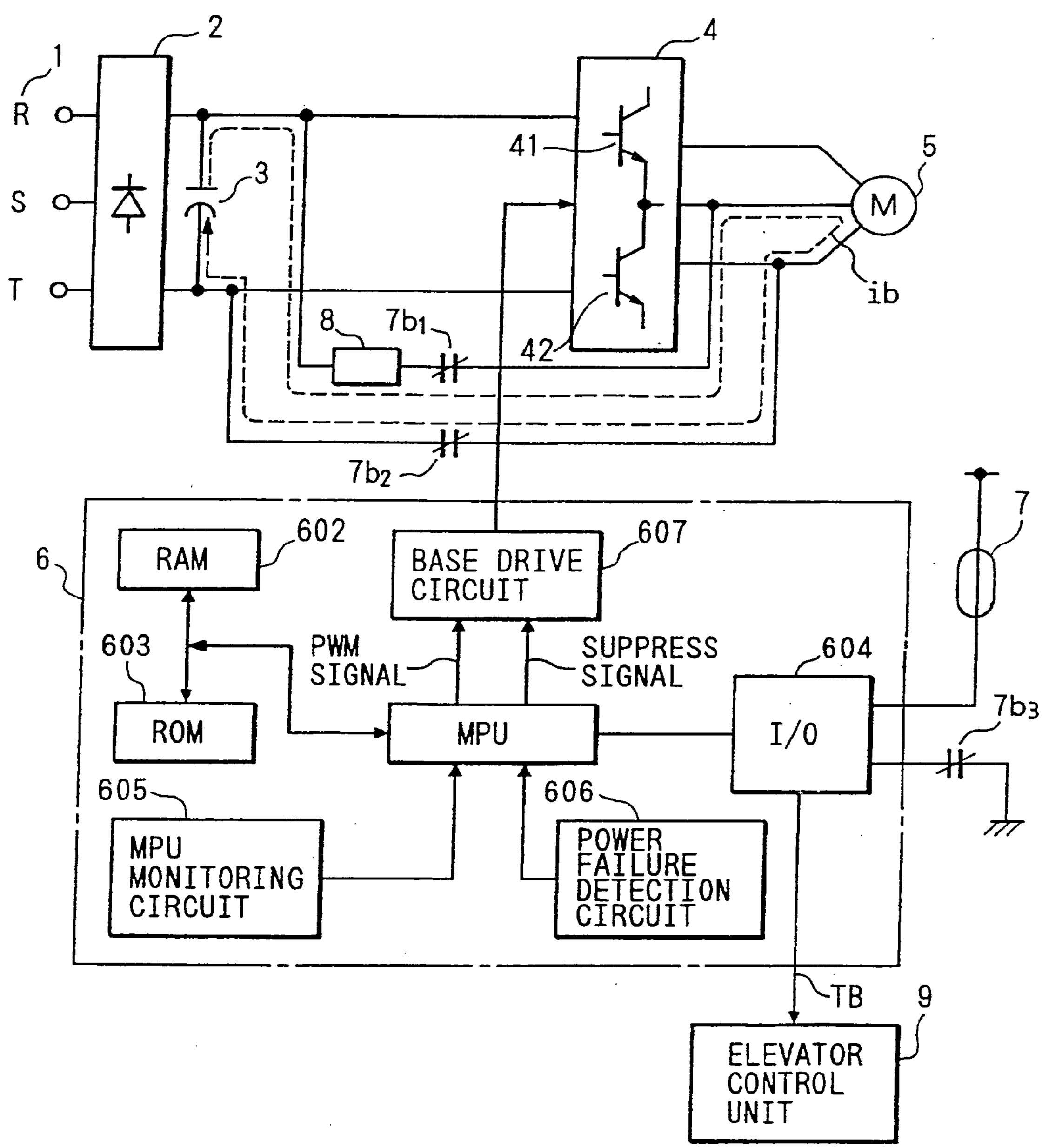
(57) In a door free run preventing device for an elevator door driving device including an induction motor 5, the induction motor 5 is fed via a converter 2, filtering capacitor 3 and inverter 4 and in the event of a power supply interruption the filtering capacitor 3 is connected to the induction motor 5 such as via a resistor 8 and relay contacts 7b1 and 7b2 so as to apply braking to the induction motor 5. A seperate capacitor (22, Fig 7) for the braking feature, supplied by a further rectifier (21) may be provided instead of connecting to the filtering capacitor 3. The inverter 4 may have thyristors (24, 25, Fig 8) which are turned on when the power supply is interrupted so as to connect the filtering capacitor 3 across the motor to provide the braking. On detection of power supply failure suppress signals are fed to the inverter transistors so that operation of the inverter is stopped.

FIG. 1



GB 2 256 100 A

FIG. 1



1
R
S
T
2
3
4
41
42
5
M
ib
8
7b1
7b2
6
RAM
602
603
ROM
605
MPU
MONITORING
CIRCUIT
BASE DRIVE
CIRCUIT
607
PWM
SIGNAL
SUPPRESS
SIGNAL
MPU
606
POWER
FAILURE
DETECTION
CIRCUIT
604
I/O
7
7b3
TB
9
ELEVATOR
CONTROL
UNIT

FIG. 2

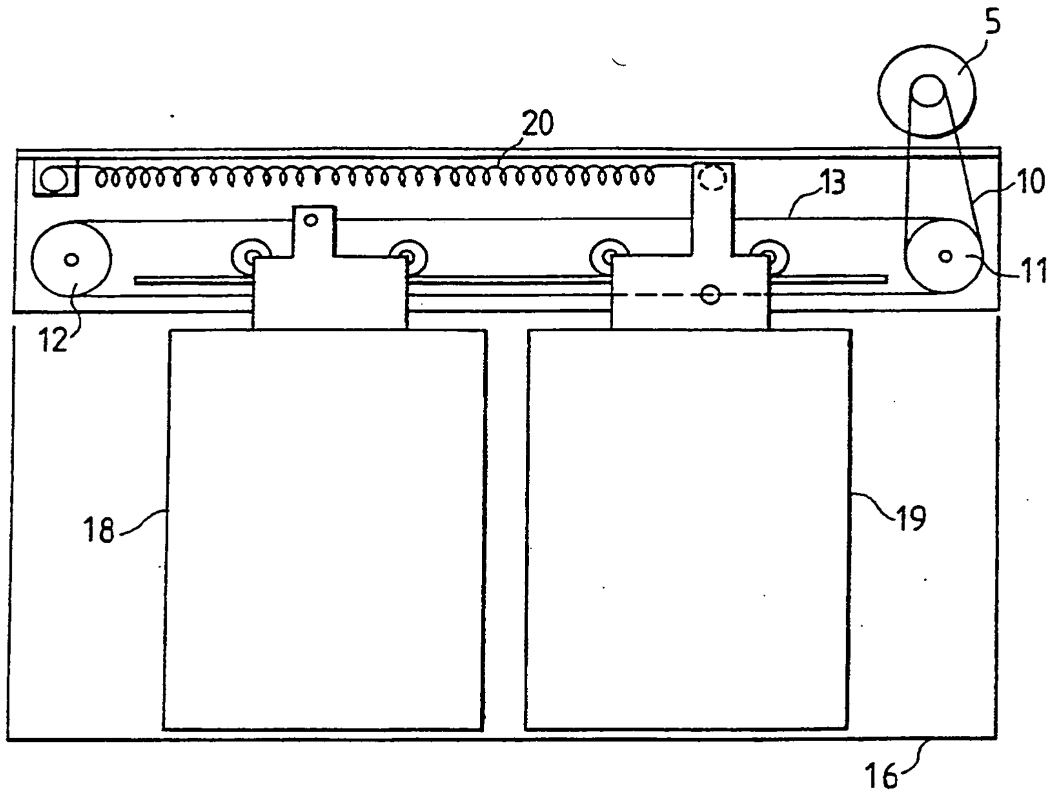


FIG. 3

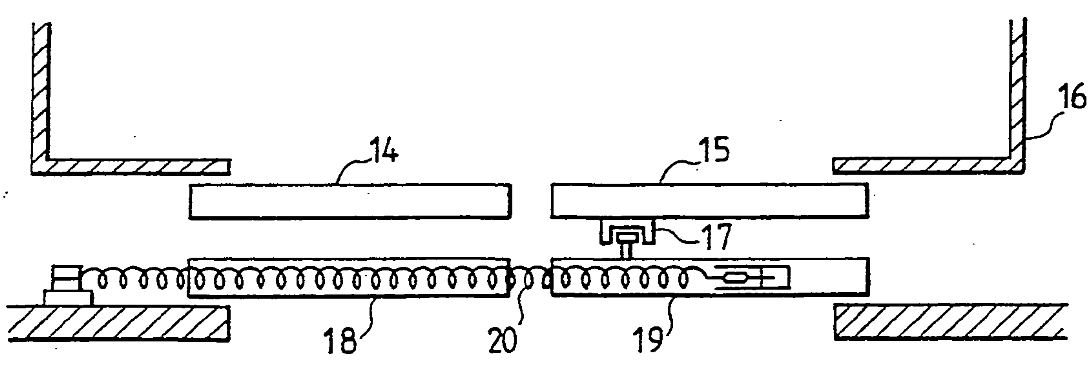


FIG. 4

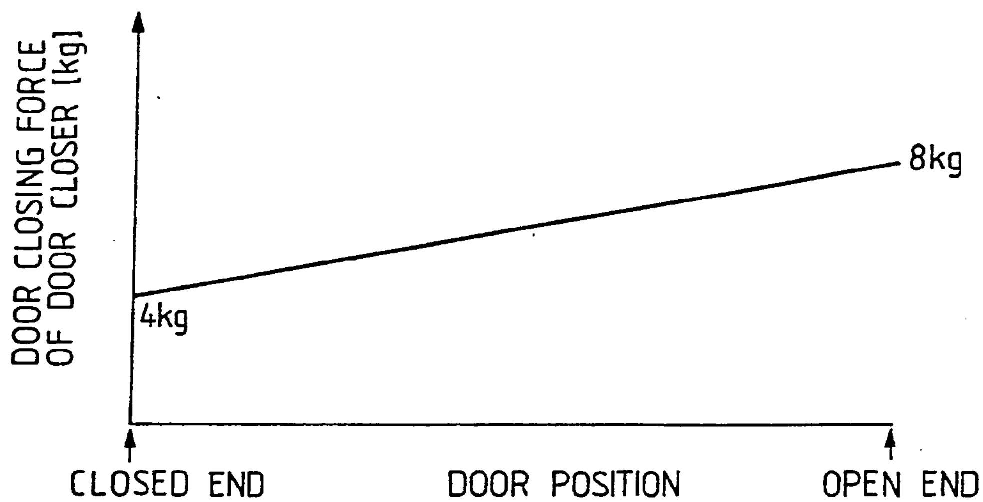
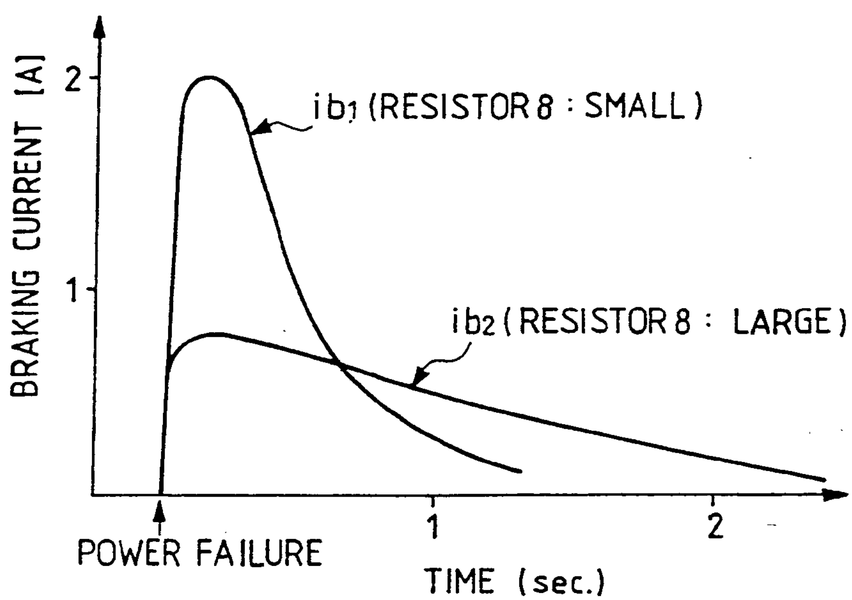

DOOR CLOSING FORCE
OF DOOR CLOSER [kg]
8kg
4kg
CLOSED END
DOOR POSITION
OPEN END

FIG. 6


BRAKING CURRENT [A]
2
1
ib1 (RESISTOR 8 : SMALL)
ib2 (RESISTOR 8 : LARGE)
POWER FAILURE
1
2
TIME (sec.)

4/6

FIG. 5

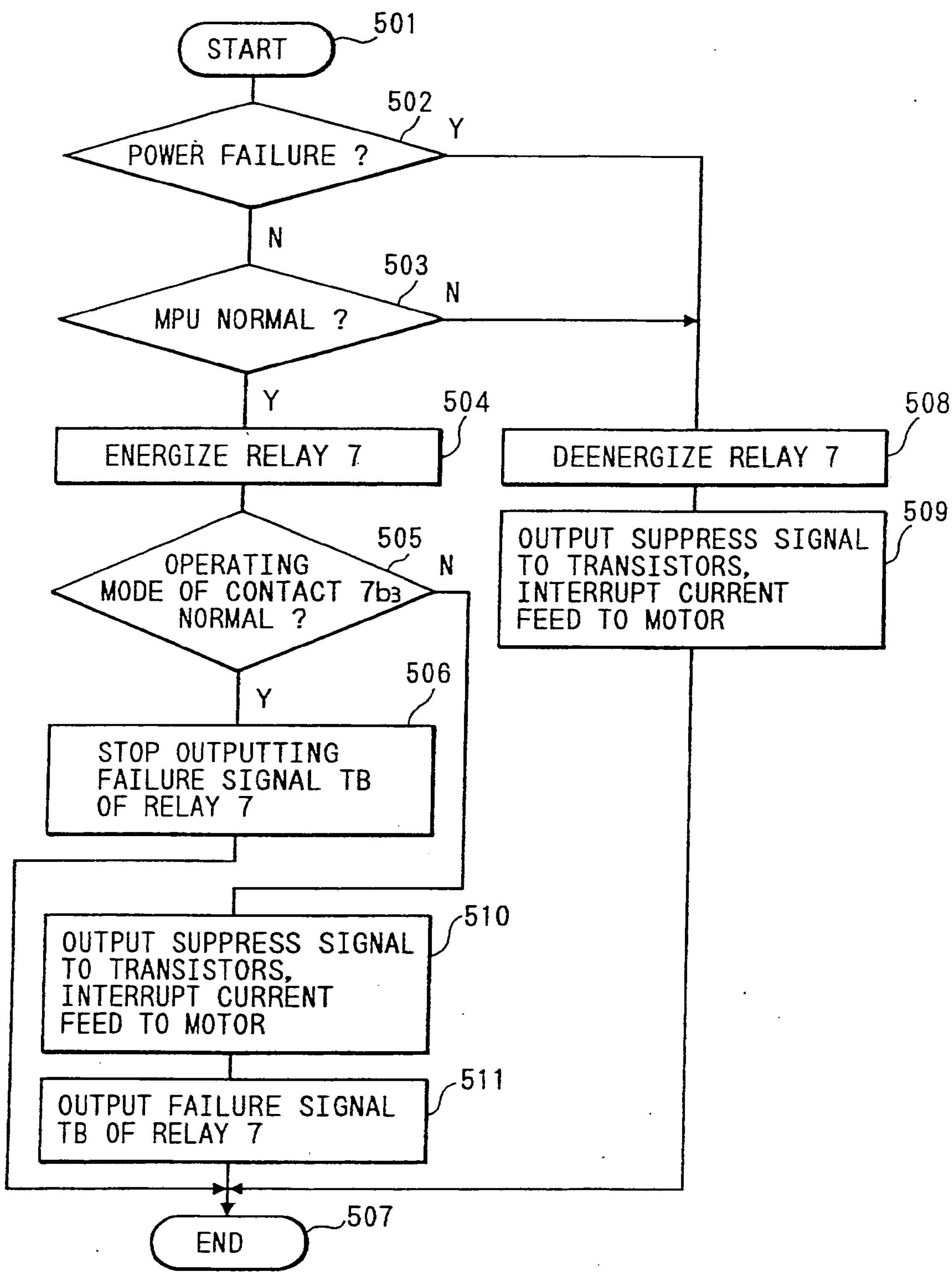
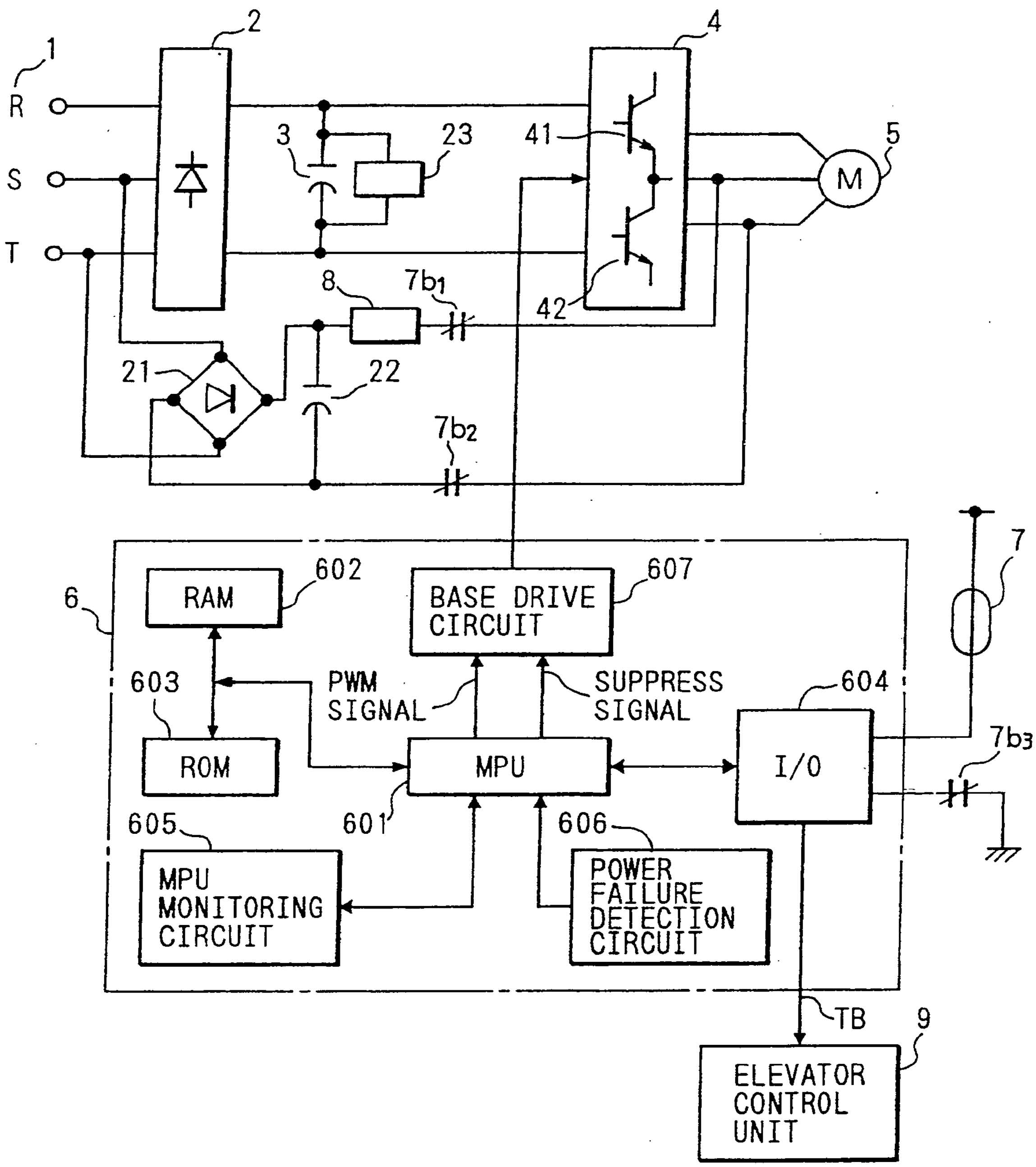
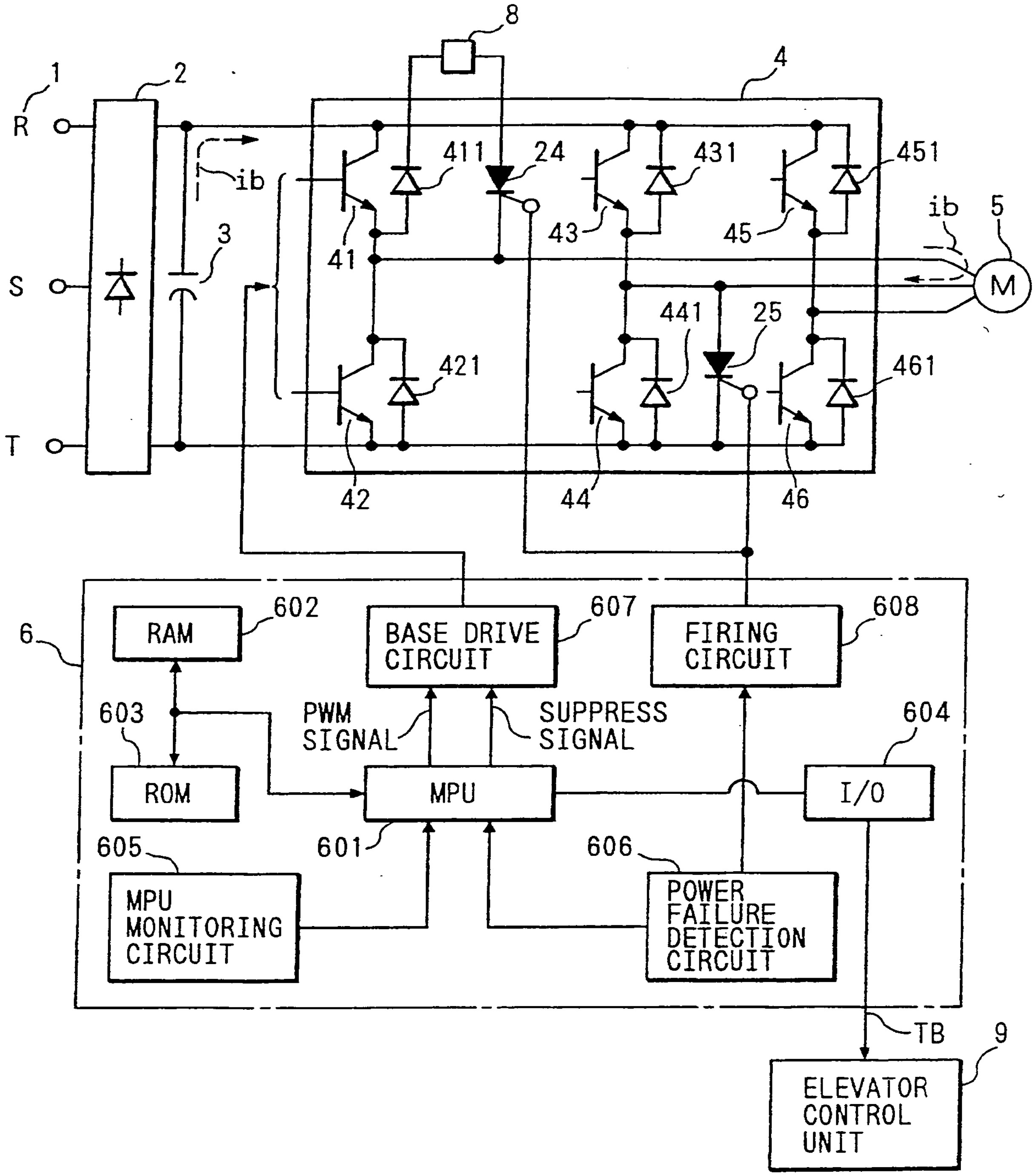

START
501
POWER FAILURE ?
502
Y
N
MPU NORMAL ?
503
N
Y
ENERGIZE RELAY 7
504
DEENERGIZE RELAY 7
508
OUTPUT SUPPRESS SIGNAL TO TRANSISTORS, INTERRUPT CURRENT FEED TO MOTOR
509
OPERATING MODE OF CONTACT 7b3 NORMAL ?
505
N
Y
STOP OUTPUTTING FAILURE SIGNAL TB OF RELAY 7
506
OUTPUT SUPPRESS SIGNAL TO TRANSISTORS, INTERRUPT CURRENT FEED TO MOTOR
510
OUTPUT FAILURE SIGNAL TB OF RELAY 7
511
END
507

FIG. 7



1
R
S
T
2
3
23
4
41
42
5
M
8
7b1
21
22
7b2
6
RAM
602
BASE DRIVE CIRCUIT
607
603
PWM SIGNAL
SUPPRESS SIGNAL
604
7
ROM
MPU
I/O
7b3
605
601
606
MPU MONITORING CIRCUIT
POWER FAILURE DETECTION CIRCUIT
TB
9
ELEVATOR CONTROL UNIT

FIG. 8



8
4
1
2
R
S
T
ib
3
411
24
431
451
41
43
45
ib
5
M
441
25
421
461
42
44
46
6
RAM
602
BASE DRIVE CIRCUIT
607
FIRING CIRCUIT
608
603
PWM SIGNAL
SUPPRESS SIGNAL
604
ROM
MPU
I/O
605
601
606
MPU MONITORING CIRCUIT
POWER FAILURE DETECTION CIRCUIT
TB
9
ELEVATOR CONTROL UNIT

Motor Driven Door Device

The present invention relates to a door device using an induction motor, and, in particular, relates to a motor driven door device suitable for an elevator door which is provided with a door closer.

A conventional motor driven elevator door device such as disclosed in JP-A-55-89182(1980) includes a circuit in which a DC motor is connected in parallel with a resistor and is constituted to initiate a braking force on the door by means of a regenerative braking of the DC motor in the event of an interruption of the motor power source. Further, JP(U)-B-53-12033(1978) discloses a motor driven door device wherein an induction motor (condenser motor) is connected to an independent DC source for a predetermined time in the event of power service interruption in order to prevent such as a passenger from being caught by the door and the door from being destroyed.

The first mentioned conventional motor driven elevator door device using a DC motor is suitable for preventing an elevator door free run and for securing safety for the passengers of the elevator in the event of power service interruption.

However, DC motors are desirable with regard to their control properties but undesirable with regard to their

maintenance properties because it is necessary to replace the brushes of DC motors due to their wear. Therefore, in association with the recent development in inverter control technology applicable to an induction motor it is desired to use a strong and maintenance free induction motor for such motor driven elevator door device.

Further, the the second mentioned conventional motor driven door device uses the separate DC power source (battery) other than the purchasing power source which causes a drawback of maintenance of the battery.

The present invention seeks to provide an easily maintained door free run preventing device during power service interruption for a motor driven door device using an induction motor.

According to one aspect of the present invention, a motor driven door device which uses a three phase induction motor as a driving source comprises a capacitor which is charged when the power source is alive and means for connecting the capacitor to the induction motor in the event of power service interruption.

According to another aspect of the present invention, a motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a capacitor connected to the output side of the converter, an inverter which inverts the DC to a three phase AC, a three phase

induction moter for driving a door which is fed by the verter, further comprises means for connecting the capacitor between input terminals of the induction motor in the event of power service interruption.

The electricity in the capacitor charged during the time when the power source is alive is discharged through the door driving induction motor at the occurrence of power service interruption. At the moment of power service interruption assuming that the door is accidentally on the way of closing or opening, the door is moved into a free run condition and the moving speed of the door may tend to increase. However a discharge current from the capacitor flows into the induction motor to induce a DC braking therein so as to suppress the would be increased door moving speed to thereby achieve a door opening and closing operation with a safe and stable moving speed.

According to another aspect of the present invention, the capacitor connected to the DC intermediate circuit between the converter and the inverter is charged when the power source is alive and is discharged toward the induction motor in a short time in the event of power service interruption. It is in fact preferable to discharge the charged electricity in the capacitor within a predetermined time after the power service interruption in view of safety during the maintenance after the power service interruption. By making use of the discharge current the above mentioned door free run is prevented with a simplified device as well

as safety during the maintenance is enhanced.

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which;

Fig.1 is a constitutional diagram of one embodiment of the motor driven door devices according to the present invention ;

Fig.2 is a view of a mechanical structure of an elevator door seen from the floor side in the motor driven door devices ;

Fig.3 is a view of the same seen from the upper side ;

Fig.4 is a characteristic diagram of a door closing force of a door closer in the motor driven door devices ;

Fig.5 is a flowchart showing a part of program in a microcomputer for the door control of the one embodiment according to the present invention ;

Fig.6 is waveforms of DC braking currents flowing into the induction motor in the motor driven door devices ;

Fig.7 is a constitutional diagram showing another embodiment of the motor driven door devices according to the present invention ; and

Fig.8 is a constitutional diagram showing a still further embodiment of the motor driven door devices according to the present invention.

Fig.1 is a constitutional diagram of one embodiment of the present invention which is applied to an elevator door device.

The AC of a three phase power source 1 is converted to a DC by a converter 2. The rectified output is fed to an inverter 4 after being smoothed by a filtering capacitor 3. The inverter 4 supplies a three phase AC of variable voltage and variable frequency to a three phase induction motor 5.

A control unit 6 controls such as the inverter 4 and is provided with a microcomputer including such as a microprocessing unit (MPU) 601, a random access memory (RAM) 602, a read only memory (ROM) 603 and an input and output interface (I/O) 604, and is further provided with a MPU monitoring circuit 605 including such as a watch dog timer monitoring the MPU 601, a power service interruption detecting circuit 606 and a base drive circuit 607 for driving such as transistors 41 and 42 in the inverter 4.

A relay 7 is controlled by the control unit 6 and includes break contacts 7b1-7b3. The filtering capacitor 3 is connected between two input lines of the induction motor 5 via the contacts 7b1 and 7b2 and a resistor 8.

An elevator door which is driven by the induction motor 5 is explained with reference to Fig.2 and Fig.3.

Fig.2 is a view of the internal mechanical structure of the elevator door seen from the front thereof and Fig.3 is a view of the same seen from the above.

Through the revolution of the three phase induction

motor 5 an endless chain extending between prockets 11 and 12 moved via a chain 10 to open and close elevator cage side doors 14 and 15. When an elevator cage 16 arrives within a predetermined landing zone, the cage side doors 14 and 15 and floor side doors 18 and 19 open and close together through an engagement device 17. In the present embodiment, a door closer spring 20 is attached to one of the floor side doors 18 and 19 and a door closing force is provided to the door which varies dependent on the position of the door as shown in Fig.4. The door closer spring 20 is an indispensable device which serves to reliably close the floor side doors when no cage 16 is at the floor in order to prevent passengers on the floor from falling into the elevator moving duct.

In such elevator door device wherein the door closing force is always acting on the floor side doors 18 and 19, when a power service interruption happens and the driving torque from the induction motor 5 disappears at the moment when the doors are on the way of closing, the door is accelerated and collides to the end of the other door by the tensile force of the door closer spring 20. Thereby a large door collision sound is generated which frightens the passengers and further because the door safety is rendered inoperative the impact when a passenger is caught between the door becomes large and dangerous.

For the above problems, according to one embodiment of the present invention as shown in Fig.1, a DC braking is

acted on the motor 5 to limit the door closing speed.

Fig.5 shows a flow chart with regard to an operating program in the microcomputer as shown in Fig.1.

At first, via a timer interruption which is very frequently executed, at step 501 the program starts, at step 502 it is judged whether or not there is a power service interruption and when it is judged that there exists a power service interruption it is determined at step 503 whether the MPU 601 is normal or not and when the MPU 601 is determined normal the process moves to step 504 to energize the relay 7. Subsequently, it is determined at step 505 whether or not the relay 7 and the contacts 7b1-7b3 are normal. Namely, when the relay 7 is energized the break contact 7b3 must have been opend so that the opening and closing conditions of the contact 7b3 are taken in to determine the normality thereof. When it is determined normal and if a failure signal TB of the relay 7 is outputted, the signal output is stopped at step 506 to complete the prosessing at step 507.

At this moment in response to the arrival of the elevator cage 16 at a predetermined floor, a door opening command is provided in accordance with a processing flow (not shown) and a PWM signal from the MPU 601 is supplied to the inverter 4 via the base drive circuit 607. Thereby, the inverter 4 speed-controls the induction motor 5 via a predetermined PWM control and the door is opened smoothly against the force of the door closer spring 20. Further, when a door closing command is provided after a predetermined

time has passed or through the operation of a door closing 'ıtton the door begins to close smoothly via the speed control of the induction motor 5.

Assuming that a power service interruption occurs at the moment when the door is on the way of closing. The power service interruption detecting circuit 606 as shown in Fig.1 generates a signal and such is sensed at the step 502 in Fig.5, then the process moves to step 508 to deenergize the relay 7 and at step 509 a gate suppress signal is outputted to such as the transistors 41 and 42 constituting the inverter 4 to stop the operation of the inverter 4. Thereby the operation of the inverter 4 is stopped and at the same time, the contacts 7b1 and 7b2 are closed to constitute a closed circuit routing through the filtering capacitor 3, resistor 8, contact 7b1, induction motor 5, contact 7b2 and the filtering capacitor 3 in Fig.1 and the charged electricity in the filtering capacitor 3 is discharged through the induction motor, in that for the filtering capacitor 3 a discharge current ib flows and for the induction motor a DC braking current ib flows.

Fig.6 shows variations of the DC braking current with respect to time. The magnitude of the DC braking current varies dependent upon the time constant determined by the capacitance of the capacitor 3 and the resistance of the resistor 8, and by selecting a proper amount of capacitance of the filtering capacitor 3 and a proper amount of resistance of the resistor 8, currents such as shown by

curves ib1 and ib2 are obtained. In an actual application, the duration of a DC braking current of about 1 sec. was satisfactory when the door opening or closing time was about 2 sec., in that the DC braking current indicated by curve ib1 was preferable.

Now, returning to Fig.5, when an abnormality of such as the MPU 601 is detected at step 503 by sensing the output of the monitoring circuit 605, in the same manner as the above the process moves to steps 508 and 509 and the operation of the inverter 4 is stopped as well as the DC braking is applied to the motor 5 to secure safety.

Subsequently, when an abnormality of the operating mode of the contact 7b3 such as caused by fusing of the contacts 7b3 is detected at step 505, the operation of the inverter 4 is stopped at step 510 as well as the failure signal TB of the relay 7 is outputted to an elevator control unit 9 at step 511. Thereby, the failure signal of the relay 7 is stored in the elevator control unit 9 and the cause of the elevator failure is promptly analyzed so that a reliable door device with a good maintenance property is obtained.

According to the above embodiment, generation of the DC braking torque to the door driving induction motor 5 in the event of a power service interruption is realized without providing a separate emergency use power source such as battery other than the purchased AC power source 1, thereby a motor driven door device having a good maintenance property as well as simple structure and economical production cost

is obtained.

Further, in addition to such advantages indicated above that the provision of the separate emergency use power source is eliminated by discharging the charged electricity in the filtering capacitor 3, which smoothes the rectified output from the converter 2, to the induction motor 5 in the event of power service interruption, by making use of advantageously the charged electricity in the filtering capacitor 3 which has to be discharged in the event of power service interruption in view of safety during the maintenance a remarkable advantage that no independent discharge circuit is needed is achieved.

Fig.7 is another embodiment of the present invention.

Only the portions different from those in the embodiment shown in Fig.1 are explained. Independent from the converter 2 in the main circuit and the filtering capacitor 3, a single phase converter 21 and a DC braking dedicated capacitor 22 are provided. For this reason a discharge resistor 23 is provided through which the charged electricity in the filtering capacitor 3 in the main circuit is discharged within a predetermined time in the event of power service interruption for keeping safety for a maintenance crafts person.

In the present embodiment too, the necessity of the independent emergency use power source such as battery is eliminated, thereby the structural simplicity, production cost economy and maintenance property of the motor driven

door device are remarkably.

Fig.8 is a still further embodiment of the present invention.

In the drawing, only the portions different from those in the embodiment shown in Fig.1 are explained. All of the transistors 41-46 and diodes 411-461 which constitute the inverter 4 are illustrated and wherein a thyristor 24 which short-circuits one positive arm of one phase in the inverter circuit and another thyristor 25 which short-circuits one negative arm of a different phase therein are added.

Those thyristors 24 and 25 are fired by a firing circuit 608 which is added in the control circuit 6. The firing circuit 608 generates a firing pulse in response to the output from the power service interruption detecting circuit 606. Accordingly, when a power service interruption occurs, with the same timing as in the previous timing, a discharge current from the filtering capacitor 3, in other words the DC braking current ib for the induction motor 5 flows through the closed circuit formed by the filtering capacitor 3, resistor 8, thyristor 24, induction motor 5, and thyristor 25. The thyristors 24 and 25 are fired by a single pulse and extinguish by themselves after the electricity in the filtering capacitor 3 is substantially discharged. Since only one single pulse is enough to fire the thyristors, the thyristors 24 and 25 are reliably fired by an electricity charged in a capacitor (not shown) contained in the firing circuit 608 even after the detection of a power service

interruption and the discharge current ib serving the braking current is surely caused to flow into the induction motor 5.

It therefore becomes possible that, a motor driven door device with an induction motor as its driving source is provided which includes a door over speed preventing device in the event of a power service interruption having a simple constitution, economical production cost and good maintenance property.

Further, according to another aspect of the present teachings in a motor driven door device including an induction motor for driving a door fed through a converter, a filtering capaciter and an inverter, by discharging the charged electricity in the filtering capacitor into the induction motor, the discharging means serves as DC braking torque generating means, thereby a motor driven door device having a further enhanced structural simplicity, production cost economy and maintenance property may be provided.

Claims

1. A motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a capacitor connected to the output side of the converter, an inverter which inverts the DC to a three phase AC, a three phase induction moter for driving a door which is fed by the inverter, further comprising means for connecting said capacitor between input terminals of said induction motor in the event of power service interruption.

2. A motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a capacitor connected to the output side of the converter, an inverter which inverts the DC to a three phase AC, a three phase induction motor for driving a door which is fed by the inverter, further comprising a discharge circuit which discharges the charged electricity in said capacitor in the event of power service interruption, and in said discharge circuit said induction motor is connected.

3. A motor driven door device which is adapted to be driven by a three phase induction motor comprising an AC power source, a converter which converts the AC to a DC, a capacitor connected to the DC side of the converter and means for connecting said capacitor to said induction motor in the event of power service interruption.

4. A motor driven elevator door device comprising means disposed at a floor side door for an elevator for providing a door closing force for the floor side door, means for

engaging the floor side door with a cage side door for the levator, a three phase induction motor for driving the cage side door, a capacitor charged by a purchased power and means for connecting said capacitor to said three phase induction motor in the event of power service interruption.

5. A motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a capacitor connected to the output side of the converter, an inverter which inverts the DC to a three phase AC, a three phase induction motor for driving a door which is fed by the inverter, further comprising means for stopping said inverter in response to a predetermined condition as well as connecting said capacitor to said three phase induction motor.

6. An inverter comprising a DC input terminal, a three phase AC output terminal, switching elements which constitute three phase positive and negative six arms, gate signal input terminals for said switching elements, means for short-circuiting one arm in positive side of one phase and one arm in negative side of a different phase and an input terminal for actuating said short-circuiting means.

7. A motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a filtering capacitor for smoothing the output of the converter, an inverter which is inputted of the voltage appearing between the both terminals of said capacitor, a three phase induction motor which is fed of the output of said inverter and a door which is driven by said three phase

induction motor, further comprising means for simultaneously turning on one arm in positive side of one phase and one arm in negative side of a different phase and continuing the condition.

8. A motor driven door device which comprises an AC power source, a converter which converts the AC to a DC, a capacitor connected to the output side of the converter, an inverter which inverts the DC to a three phase AC, a three phase induction motor for driving a door which is fed by the inverter, further comprising means for connecting said capacitor between input terminals of said induction motor via a resistor in the event of power service interruption.

9. A motor driven door device comprising a door provided with a mechanical open or closing force in one of open or closing direction, a three phase indnction motor for opening and closing said door, an AC power source, a converter which converts the AC to a DC, a capacitor which is connected to the DC side of said converter and means for connecting said capacitor to said induction motor in the event of power service interruption.

10. A motor driven door device substially as herein described, with reference to the accompanying drawings.

16

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9208250.2

Relevant Technical fields

(i) UK Cl (Edition K) H2J(JDPF,JLRB,JBDB,JBX,JS); E2M;G3N(NGK2A,NGK2B,NGK2,NGL, NGBA3)

(ii) Int Cl (Edition 5) H02P 3/24; B66B 5/02,13/00, 13/06,13/14,13/24,13/26

Search Examiner

B J EDE

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

18 AUGUST 1992

Documents considered relevant following a search in respect of claims 1-4, 8 AND 9

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2182217 A (MITSUBISHI) see Figure 2	1-4,8 and 9
Y	GB 2068663 A (MITSUBISHI) see 15, Figure 2	1-4, 8 and 9
Y	GB 748690 (STC) see C	1-4,8 and 9
Y	WO88/01450 A1 (OTIS ELEVATOR CO) see Figure 1	1-4,8 and 9

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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